In a first aspect, the disclosure provides a reactor system for the acetylation of lignocellulosic materials, the system comprising a reaction vessel having a closable aperture suitable for the introduction of lignocellulosic material, a vacuum connection suitable for creating vacuum in the reaction vessel, a liquid-inlet and/or liquid-outlet for acetylation fluid, and a gas-inlet and gas-outlet connected to a first gas flow loop, said first gas flow loop comprising a gas flow line connecting the gas-inlet and the gas-outlet, said gas flow line connected to a heat exchanger and at least one fan, wherein the inlet and the outlet of the first gas flow loop are positioned such as to allow gas circulation through the reactor over the diameter of the reaction vessel and wherein the inlets and the outlets of the gas flow loop are positioned for gas circulation transversal to the length of the reactor.

In another aspect, the disclosure provides a process for the acetylation of lignocellulosic material, comprising introducing the lignocellulosic material into a reaction vessel as defined above, filling the reaction vessel with acetylation fluid so as to submerge the lignocellulosic material; allowing the lignocellulosic material to become impregnated with acetylation fluid; removing excess acetylation liquid, applying heat to the impregnated lignocellulosic material by circulating heated gas through the reactor via said first gas flow loop and, where applicable, via said further gas flow loops, so as to allow acetylation of the lignocellulosic material to occur.

In yet another aspect, the disclosure relates to a process for the acetylation of lignocellulosic material, comprising the steps of (a) impregnating the lignocellulosic material with an acetylation fluid and removing the excess acetylation liquid; (b) heating the impregnated lignocellulosic material by means of a flow of heated gas so as to allow acetylation of the lignocellulosic material to occur; (c) lowering the pressure to which the lignocellulosic material is subjected so as to allow residual acetylation fluid to migrate out of the lignocellulosic material; (d) allowing gas to act as a stripping gas for the migrated residual acetylation fluid by subjecting such gas to condensation; wherein the gas subjected to condensation is a portion of the circulating heated gas flow; and wherein step (d) comprises decreasing the volume fraction of the portion of the gas that is split off and condensed.

Claims

1. A reactor system for the acetylation of lignocellulosic materials, the system comprising a reaction vessel having a closable aperture suitable for the introduction of lignocellulosic material, a vacuum connection suitable for creating vacuum in the reaction vessel, a liquid-inlet and/or liquid-outlet for acetylation fluid, and a gas-inlet and gas-outlet connected to a first gas flow loop, said first gas flow loop comprising a gas flow line connecting the gas-inlet and the gas-outlet, said gas flow line connected to a heat exchanger and at least one fan, wherein the inlet and the outlet of the first gas flow loop are positioned such as to allow gas circulation through the reactor over the diameter of the reaction vessel and wherein the inlet and the outlet of the gas flow loop are positioned for gas circulation transversal to the length of the reactor.

2. A reactor system according to claim 1, wherein the inlet for the first gas flow loop is connected to a gas distribution device positioned between the inlet and the inside of the reaction vessel.

3. A reactor system according to claim 2, wherein the gas distribution device is a distribution plate.

4. A reactor system according to claim 1, 2 or 3, comprising a plurality of gas flow loops connecting further inlets and outlets of the reaction vessel, said further inlets and outlets positioned such as to allow gas circulation over the diameter of the reaction vessel, said first and further inlets and outlets being divided over the length of the reaction vessel.

5. A reactor system according to any one of the preceding claims, wherein the reaction vessel comprises an outlet connected to an additional gas flow line, said additional gas flow line connected to a condenser system.

6. A reactor system according to claim 5, wherein the reactor comprises an inlet for condensed liquid, positioned downstream of the condenser system.

7. A reactor system according to any one of the preceding claims, wherein the vacuum connection is located on the reaction vessel, on the gas loop or on both.

8. A reactor system according to any one of the preceding claims, wherein the heat exchanger is located inside the reactor, preferably in the

form of at least one heat exchanger on the gas-inlet side and at least one heat exchanger on the gas-outlet side of the reactor.

9. A reactor system according to any one of the preceding claims, designed so as to allow a reversal of the direction of the gas flow.

10. A process for the acetylation of lignocellulosic material, comprising introducing the lignocellulosic material into a reaction vessel as defined in any one of the preceding claims, filling the reaction vessel with acetylation fluid so as to submerge the lignocellulosic material; allowing the lignocellulosic material to become impregnated with acetylation fluid; removing excess acetylation liquid, applying heat to the impregnated lignocellulosic material by circulating heated gas through the reactor via said first gas flow loop and, where applicable, via said further gas flow loops, so as to allow acetylation of the lignocellulosic material to occur.

11. A process for the acetylation of lignocellulosic material, comprising the steps of (a) impregnating the lignocellulosic material with an acetylation fluid and removing the excess acetylation liquid; (b) heating the impregnated lignocellulosic material by means of a flow of heated gas so as to allow acetylation of the lignocellulosic material to occur; (c) lowering the pressure to which the lignocellulosic material is subjected so as to allow residual acetylation fluid to migrate out of the lignocellulosic material; (d) allowing gas to act as a stripping gas for the migrated residual acetylation fluid by subjecting such gas to condensation; wherein the gas subjected to condensation is a portion of the circulating heated gas flow; and wherein step (d) comprises decreasing the volume fraction of the portion of the gas that is split off and condensed.

12. A process according to claim 10 or 11, wherein the impregnation with acetylation fluid is conducted by first putting the reaction vessel, when filled with the wood or other lignocellulosic material, under vacuum and then introducing the acetylation fluid while maintaining vacuum, preferably so as to completely submerge all the wood elements.

13. A process according to any one of the claims 10 to 12, wherein the lignocellulosic material is solid wood having a size of at least 1 m in at least one dimension.

14. The use of a reactor system to conduct a process for the acetylation of lignocellulosic materials, the reactor system comprising a reaction vessel having a closable aperture suitable for the introduction of lignocellulosic material, an inlet and outlet for acetylation fluid, and an inlet and outlet connected to a first gas flow loop, said first gas flow loop comprising a gas flow line connecting the inlet and the outlet, said gas flow line connected to a heat exchanger and at least one fan, the use being for an acetylation process wherein solid wood is submerged into a liquid acetylation medium.

15. A use according to claim 14, wherein the reactor system is according to any one of the claims 1 to 9.

16 A use according to claim 14 or 15, wherein the process for the acetylation of lignocellulosic materials, wherein the process is according to any one of the claims 10 to 13.